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## INTRODUCTION

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This book is a collection of activities in physics and chemistry for children from two to eight years old. The activities capitalize on the fact that children are very good at asking questions and then seeking answers through their own direct actions on objects. So the activities are designed around the idea that children learn best when they act as researchers and experimenters, working with a wide variety of materials in many different ways. The results of such experimenting are quite dynamic, and sometimes unpredictable to adults. You will quickly become a learner as well as a guide. The information which follows will help you understand how you can make the activities in this book work best for you and your children.

### **The Adult's Role**

Learning can be enhanced by teachers and parents in several ways. First, children need an environment in which exploratory learning is both possible and valued. You need to make sure their play space is safe, can take spills and messes, and can easily be cleaned up by the children. Ideally, they should be allowed to leave things out for extended periods if necessary, even overnight. The emotional environment should be relaxed and positive, with your respect for the children and their ways of learning freely expressed. But you should also expect self-discipline from the children so that they do not endanger themselves, each other, or the materials and environment. These conditions will help you to encourage learning and creativity in the children.

Second, you can provide materials which are simple and yet which have many possible uses, such as blocks, sand, water. These materials encourage widely varied experimentation and sensory exploration. They provoke creative thinking by demanding that the children invent their own uses, responding tangibly to actions initiated by each other. To obtain the greatest benefits from open-ended materials, you need to allow plenty of opportunities to just "mess about," experiment, make noise, make a clutter, and try out ideas.

Third, you can talk to the children about their experiments. It is especially helpful to have them explain what they are doing, why, and what they expect to happen as a result. You can ask questions which encourage the children to try new actions and materials, make predictions, evaluate outcomes. These conversations about the experiments help children clarify what it is they are trying to achieve and what they may be learning through their actions. You are encouraging use of new vocabulary and articulation of ideas. You are also communicating to the children that you value their ideas and that scientific explorations are important.

Fourth, you can provide occasions when several children work together with a set of materials. Just working together, they will discuss their ideas, challenge one another's thinking and develop intellectual and social skills. Since each child brings a very personal perspective to the learning experience, conversations among children will encourage the expansion of all children's thinking. The children will encourage each other to explore and experiment more fully and to verbalize what they each experience. This is a time for you to be a careful observer, responding when the children seek your help or attention while keeping your interaction with them focused on their requests.

Fifth, you can observe your children to determine when they are ready for new or tougher intellectual challenges. If our children lose interest in a toy or material, you can help them find new ways of using it. They might use it for different purposes, combine it with different materials, or combine its parts in new ways. All these activities extend

the life of the toy or material while encouraging the children to develop complex thinking strategies and creativity. Sometimes it helps if you put a toy or material away for a time, bringing it out again when the children's understandings have matured. Since you have ultimate control over the materials available to the children, it is your observations and skilled choices which will most help promote learning and creativity.

## Using This Book

The activities in this book all emphasize the development of higher order thinking skills as defined by Benjamin Bloom in his *Taxonomy of Educational Objectives*.

**Application** involves the use of knowledge and understanding, especially in building new ideas and predicting future outcomes. Ideas applied can be more completely examined and more fully understood.

**Analysis** is the examination and comparison of ideas and events to find their similarities, differences and other relationships.

**Synthesis** takes ideas and puts them together in new ways or takes unrelated ideas and creates relationships among them.

**Evaluation** leads to the judgment of the worth and value of an idea or event, to a decision about "best," or other personal preference.

The activities are also designed to promote selected thinking skills in science problem solving, creativity, and communication. Each activity addresses some skills from each area.

**Science problem solving skills** include:

*problem finding*: seeing ambiguities, incongruities and omissions in an event or situation

*observation*: using all five senses, movement and measurement to learn about a situation or event

*hypothesis formulation*: speculating on why and how a particular situation or event came to pass

*hypothesis testing*: investigating to decide if an hypothesis is correct

*data collection*: gathering specific observations about a situation or event

*data organization*: structuring data so that it can be understood

*data interpretation*: putting together specific facts to create a larger idea

*solution finding*: producing many solutions for the original problem

*solution testing*: finding out which solution works best

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# BALLOONS

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physics; toddler

designed by Susan Gayle Golden

**Purpose:**

To investigate the effects of gravity on balloons

**Thinking skills:**

*Science problem solving:* Observation, hypothesis formulation, hypothesis testing

*Creativity:*

*Originality:* use of unusual actions, engaging dramatic imagination

*Communication:* Verbal, non-verbal, listening

**Vocabulary:**

Balloon, air, bounce, float, blow, light, heavy, helium

**Prerequisites:**

Familiarity with balloons and with “chase the ball” type games

**Materials:**

Many balloons, some filled with air, some with helium, some partly filled with water (optional), some empty; string, magic markers; large indoor area with tub or plastic wading pool

Inflate helium balloons in advance and attach strings long enough to reach from ceiling to floor. Have other materials ready nearby.

**Introduction:**

Give the children the helium balloons to play with, helping them discover that they can pull on the strings to retrieve the balloons. While they play, inflate a balloon with air and slowly let it blow against the faces of interested children. Repeat this a couple of times before tying a knot in the end. Distribute this and the other air-filled balloons, encouraging comparisons with helium balloons. If there is interest, let the children draw on an empty balloon with a magic marker before you blow it up. Help the children observe the drawing as the balloon inflates.

**Continuation:**

Ask questions (rephrased for your children) and talk about what the children are doing and can do with the balloons. Model actions you have not observed, such as blowing on the balloons or kicking them. You may also wish to introduce the water balloons in the tub. Be sure to keep attention moving among the different types of balloons and the different actions.

*NOTE:* Water balloons could be saved for playing with balloons on a second occasion. If so, modify questions and vocabulary appropriately.

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# COOKING

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chemistry; n-k/primary

**Purpose:**

To experiment with simple, quick-cook foods

**Thinking skills:**

*Science problem solving:* Observation, solution finding, solution testing, communication of solutions

*Creativity:*

*Originality:* Uniqueness of solutions

*Elaboration:* Detailing of solutions

*Communication:* Verbal, interpersonal

**Vocabulary:**

Mixture, mix, stir, thicken, heat, chill, boil, simmer, set (verb)

**Prerequisites:**

None

**Materials:**

Instant and cooked pudding mixes, jello mixes, instant soft drink, tea, cocoa mixes, dry powdered milk; water, soda, liquid milk; bowls, spoons, bowl scrapers, plastic cups, sauce pans, stove or hot plate, refrigerator; paper towels, sponges.

Set out the materials so they are clearly identifiable.

**Introduction:**

Show the children the dry foods, labeling the substances as you do. Tell them these are all foods that people mix to eat or drink and that you would like them to make up their own recipes with these foods. Organize groups of 3-4 and let them explore, discuss and begin experimenting. Allow them to taste a tiny bit of a substance if they need to.

**Continuation:**

Observe the children's progress and begin asking questions to further their thinking. Introduce vocabulary throughout discussions.

**Application:**

How do you plan to use your ingredients?

What will happen when you mix (*names of two substances*)?

What are you planning to make?

What do you expect your mixture to taste (*look, smell, feel*) like?

What will happen if you heat (*chill*) your mixture?